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Optimization of a production assembly process using multipoint approximation method

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Keywords Structural optimization, Multibody dynamics, Manipulators, Assembly

The paper concerns a production assembly performed by a manipulator. A peg-in-hole insertion process is modelled using 2D finite element model of manipulator with flexible links. The simulation procedure includes inverse kinematic and dynamic analyses, and manipulator control. To prevent failure of an error-corrupted assembly, an adjustable remote centre compliance (ARCC) mechanism developed at the Delft University of Technology is considered. Determination of properties of the ARCC is formulated as an optimization problem. The production speed should be as high as possible while imposing restrictions on the values of contact forces and initial misalignments of the parts. To solve the optimization problem a multipoint approximation method is used. The results of the optimization are presented and discussed.

Optimizing the process flow for complex design projects

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Keywords Process management, Genetic algorithms, Multidisciplinary design, Design optimization

The design cycle of large, multidisciplinary design projects requires the decomposition of the complex system into design processes and their couplings. Some processes may be grouped into iterative subcycles. In optimizing such a coupled system, it is essential to determine the best sequence of the process flow within these subcycles to reduce design cycle time and cost. Many decomposition approaches assume the capability is available to determine what sequence of execution will be imposed during the design cycle. Unfortunately, this is often a complex problem and beyond the capabilities of a design manager. A genetic algorithm can be applied to allow the design manager to rapidly examine many combinations for sequencing the process flow in an iterative subcycle and to optimize the sequence based on cost, time, and iteration requirements. A sample test case is presented to show the effects of optimizing the sequence with a genetic algorithm.

A multi-thread tabu search algorithm

A.M. Connor

Keywords Optimization, Tabu search, Fluid

This paper describes a novel refinement to a tabu search algorithm that has been implemented in an attempt to improve the robustness of the search when applied to particularly complex problems. In this approach, two tabu searches are carried out in parallel. Each search thread is characterised by its own short term memory, which forces that point out of local optima. However, the two search threads share an intermediate term memory so allowing a degree of information to be passed between them. Results are presented for both unconstrained and constrained numerical functions as well as a problem in the field of hydraulic circuit optimization. Simulation of hydraulic circuit performance is achieved by linking the optimization algorithm to the commercial simulation package Bathfp.

Shape sensitivity analysis of geometrically non-linear structures

E. Parente Jr and L.E. Vaz

Keywords Design, Shape optimization, Non-linear analysis

The design sensitivity analysis plays a central role in the solution of shape optimization problems. The evaluation of shape sensitivities must be both accurate, since it affects the convergence rate of the optimization process, and efficient, since it can be a very time consuming task. In this paper, the analytical and the semi-analytical methods of shape sensitivity analysis are applied to structures subjected to large displacements. Isoparametric and truss elements are addressed. Numerical examples are performed and comparisons between the analytical and semi-analytical methods are made in relation to accuracy.

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Optimisation techniques for inverse prediction of structural damage

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Keywords Optimization,
Non-linear analysis, Inverse problems,
Finite element analysis

A procedure for damage identification in structure is proposed based on optimisation techniques, where both the location and the extent of structural damage can be estimated using only a limited number of modified natural frequencies. No knowledge of the modal shapes of the damaged structure is required. On the basis of the non-linear sensitivity analysis for structural dynamic systems, a set of basic equations for the exact relationship between the modification of structural parameters and the modification of modal parameters is generated. The approximate equations for estimating structural damage are obtained from the generated basic equations with different levels of approximation. Two optimisation techniques, the non-linear optimisation technique and the optimisation and iteration technique, are utilised to determine structural damage from the derived equations. Finally, different numerical examples are used to demonstrate the effectiveness of the proposed method.